

FECAL INDICATOR BACTERIA 7.1

Fecal indicator bacteria are used to assess the quality of water because they are not typically disease causing, but are correlated to the presence of several waterborne disease-causing organisms (pathogens). The concentration of indicator bacteria (the term “indicator bacteria” is used synonymously with fecal indicator bacteria in this section) is a measure of water safety for body-contact recreation or for consumption.

- ▶ Wastes from warm-blooded animals contribute a variety of intestinal bacteria that are pathogenic to humans.
- ▶ Body contact with water that contains pathogens of the genera *Salmonella*, *Shigella*, and *Vibrio* can result in several types of disease in humans, including gastroenteritis and bacillary dysentery, typhoid fever, and cholera.
- ▶ The presence of *Escherichia coli* (*E. coli*) in water is direct evidence of fecal contamination from warm-blooded animals and indicates the possible presence of pathogens (Dufour, 1977).

The most widely used indicator bacteria are of the total coliform, fecal coliform, enterococci, and fecal streptococci groups, and *E. coli*. Bacteriological tests are used to assess the sanitary quality of water and the potential public health risk from waterborne diseases. This section describes five membrane filtration methods for identifying and enumerating fecal indicator bacteria (Britton and Greeson, 1989; U.S. Environmental Protection Agency, 1985 and 1991a).

Fecal indicator bacteria:
measures of the
sanitary quality of
water.

Water-quality criteria have been developed by the U.S. Environmental Protection Agency (USEPA) for concentrations of indicator bacteria in recreational, shellfish growing, ambient, and potable waters.

- ▶ Typical concentrations of indicator bacteria in contaminated and uncontaminated surface waters (table 7.1–1) are often much higher than water-quality criteria established as safe levels by USEPA. For bathing water, the geometric mean concentration established by the U.S. Environmental Protection Agency (1976) for fecal coliform bacteria is 200 col/100 mL (colonies per 100 milliliters). In 1986, the USEPA modified the Federal criteria so that *E. coli* and enterococci bacteria are now the recommended indicator bacteria (U.S. Environmental Protection Agency, 1986).
- ▶ Ground water typically contains lower concentrations of indicator bacteria than surface water.

E. coli and enterococci are currently the preferred indicators for recreational waters because both are superior to fecal coliform and fecal streptococci bacteria as predictors of swimming-associated gastroenteritis in marine and fresh water (Cabelli, 1977; Dufour and Cabelli, 1984). The freshwater criterion for *E. coli* in bathing water is a geometric-mean concentration of 126 col/100 mL. The freshwater criterion for enterococci is a geometric-mean concentration of 33 col/100 mL (U.S. Environmental Protection Agency, 1986, p. 15). For potable waters, the detection of as few total coliforms as 4 col/100 mL, and the detection of 1 col/100 mL of either fecal coliform or *E. coli* warrant concern for public health.

Table 7.1–1. Ranges of fecal indicator bacteria typically found in surface water and contaminated surface water (modified from Bordner and Winter, 1978, p. 127; American Public Health Association and others, 1992, p. 9–56, 9–60; American Public Health Association and others, 1985, p. 905; U.S. Environmental Protection Agency, 1986)

| Bacterial group | Surface water, colonies per 100 milliliters | Fecal-contaminated surface water, colonies per 100 milliliters |
|-------------------------|--|--|
| Total coliforms | <1 to 80,000 | 1,200 to > 4,000,000 |
| Fecal coliforms | <1 to 5,000 | 200 to > 2,000,000 |
| <i>Escherichia coli</i> | <1 to 576 | 126 to > 2,000,000 |
| Fecal streptococcus | <1 to 1,000 | 400 to > 1,000,000 |